

Tracking contamination through technology

Faecal contamination in our waterways might not be something people like to think about, but given the severe health and economic implications and the increasing pressure our lakes, rivers and coastal waters are under from rural and urban land-use intensification, we don't have a choice.

"Councils are on the frontline when it comes to monitoring and ensuring water quality and protecting the public from harmful contaminants, but they are having to deal with a very complex situation, one where just identifying the source of the problem can be a real challenge," says Cawthron's coastal and estuarine scientist Chris Cornelisen.

Which is why Cawthron, a private research institute based in Nelson, has invested in developing tools that enable councils to solve individual faecal contamination problems. Called Microbial Source Tracking, or MST, the technology can help councils confirm not only that contamination is occurring in a waterway, but what types of animals it's coming from – whether it's human or from cows for example, and where it is likely entering the waterway.

Cornelisen contends the new technology is a leap forward on traditional testing and has the potential to revolutionise water quality management for local councils. It also has big implications for the aquaculture

industry, iwi and recreational users of our waterways, tourism operators who rely on New Zealand's clean, green image, and a dairy industry under growing pressure to demonstrate it is cleaning up its act.

Used largely in a research capacity around the world for a number of years, he says MST's time as a water quality management tool has definitely come in New Zealand.

"We're in a unique situation in that as a small country we can effectively validate and integrate MST technology from a local to national scale. At the same time, the suitability of our rivers, lakes and near-shore coastal waters for swimming, shellfish harvesting and aquaculture is coming under increasing scrutiny from environmental organisations and the community, particularly with publications such as the 2007 National State of the Environment Report highlighting the high number of water bodies failing to meet water quality standards."

The MST technology that Cawthron employs is based on detecting DNA markers that target bacteria or viruses found in the gut of a specific host animal. This allows researchers to determine whether faecal bacteria in water are from humans, cows, sheep, birds, dogs or another species.

That is something that hasn't been

possible with conventional testing, which for many years has relied solely on determining the presence of bacteria such as enterococci and E.coli. The problem with that is that those bacteria can come from any warm-blooded animal or be living in the sediment.

"When red flags are raised because of the level of bacteria, councils have taken a precautionary approach, banning swimming or shellfish gathering, for example. This can lead to conflicts and there have been cases where marine farms and harvest areas have been forced to shut down for months because of possible human faecal contamination, when in actual fact the contamination culprit could be birds or cows."

Cawthron started working on MST technology several years ago in collaboration with researchers from American universities, transferring host-specific markers developed in the US for application in the New Zealand environment. It has also invested a lot of time and money validating and testing a suite of bacteria and virus markers, alone and in collaboration with MST scientists at ESR in Christchurch. Used in combination with information on catchment hydrology and land use, Cornelisen foresees MST results standing up to the scrutiny of the likes of the Environment Court and in turn facilitating action toward cleaning up our waters.

Cawthron's MST scientist Dr Marek Kirs is particularly excited about the institute's development of a marker for the human polyomavirus.

"Tests so far indicate it's the perfect marker for confirming human contamination – it is very common among the population and is highly specific to humans," says Marek. "If you are a city council that's probably the first thing you want to rule out, given the risk from diseases such as salmonella and hepatitis A."

Cawthron has trialled its suite of MST tools, including in what Cornelisen describes as a classic case for the Nelson City Council which had an ongoing contamination problem with the lower Maitai River.

"It had been polluted for a long time to levels requiring remedial action. After spending a lot of time and money on traditional monitoring methods, they still had no idea where the contamination was coming from or what

was causing the problem."

After E.coli counts were found to have reached 'red alert' level health authorities had posted temporary signs, warning that the water in the river failed bathing water standards.

"The big concern was that the contamination was human, but it was also possible it was related to wildfowl or dogs, or be entering the system from the surrounding catchment upstream. We went in and, using a suite of MST markers, were able to confirm that there was a problem with human contamination. We could even tell them what side of the river it was coming in from, right down to the drains that were leaking it. They could then work towards fixing the problem."

In another project with the Tasman District Council and Landcare Research, Cawthron used MST markers together with its expertise in hydrology and coastal oceanography to track contamination in the upper Motueka River catchment (following a flood), down to Tasman Bay and six kilometers offshore into shellfish located within New Zealand's largest aquaculture management area. MST markers

detected in the shellfish confirmed the presence of contamination from ruminant animals, such as cows and sheep.

"We are excited about these results and the promise MST also holds for aquaculture," Cornelisen says.

"The seafood industry sees the potential and has recently granted Cawthron Seafood Innovations Ltd funding for optimising methods for detecting MST markers in shellfish."

Cawthron, in collaboration with ESR, has applied for funding from the Foundation for Research and Technology EnviroLink Tools Programme to validate and test MST markers for integration with council water quality monitoring programmes. This application has strong support from Regional Councils and if funded will enable the integration of markers over a two-year period.

"A main priority is helping councils identify sources of contamination that are causing them to fail water quality standards – particularly with regard to human contamination.

"We also want to work with individual councils, using MST to help them solve problems specific to their region, such as

we did in the Nelson pilot."

He says the implications of a contaminated waterway way can be terrible for a region.

"We recently had a call from a council in response to a news article over high bacteria counts in a small stream. But all a high bacteria count does is raise questions and fuel speculation. That's where MST can come in and identify and rapidly solve the real problem. Together with our hydrology and coastal oceanography expertise, we have all the ingredients to be able to provide councils with a complete picture to a complex problem rather than just give a lab result.

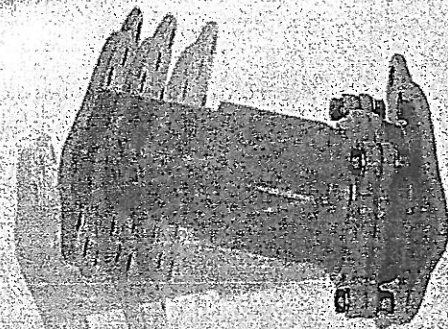
"Councils can spend money for years doing faecal indicator bacteria monitoring and it's not going to tell them much. MST isn't a panacea in itself, but it is another layer to help councils look at the bigger picture and think about newer and smarter ways to actually solve the contamination problem quickly.

"If they are prepared to invest in a suitably designed project to find out what the source of the problem is, the long-term benefits are huge."

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